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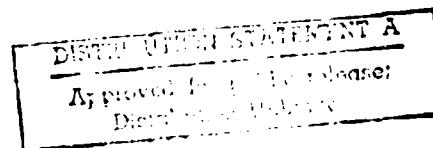
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HIGH ALTITUDE OBSERVATORY
of
Harvard University and
University of Colorado,
Boulder, Colorado

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FINAL REPORT

4 May 1953



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Prepared Under
ONR Contract N8onr-64801
NR 046-708
for
Development and Construction of Solar Research Instruments

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ABSTRACT

As the final report under ONR Contract N8onr-64801, this is a summary statement of research and development undertaken since the inception of the subject contract. Under Contract N8onr-64801 High Altitude Observatory assumed responsibility and continued work previously being carried out by High Altitude Observatory under Contract N6ori-131/III held by the University of Colorado. It is intended that this final report should serve as an index to work done, reports issued, and such administrative matters as property accounting and disclosure of inventions.

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I. STATUS OF CONTRACT TERMINATION

During the past few months all documents necessary to the termination of the contract, with the exception of this report and the final voucher, have been submitted. The final voucher will be submitted at about the same time as this final report.

Letters of 24 November 1952 and 10 December 1952 from Mr. Robert J. Low, Administrative Officer of High Altitude Observatory, to Mr. James A. Williams, Contract Administrator, ONR Branch Office, Chicago, submitted: (a) Final Inventory, (b) Proposal for Equipment Loan Contract, (c) Supplement to the Proposal, and (d) Patent Certificate. Questions concerning these documents were raised by Mr. Williams in a letter dated 23 December 1952, and were answered by Mr. Low in a letter of 24 February 1953. A "Final Inventory Certificate" accompanied this letter.

There was some delay in conclusion of the contract by the negotiation of a fixed overhead rate to apply from 1 October 1950 to the end of the contract period. A temporary rate had been in use. A letter of 2 January 1953 from Mr. H. P. Wighton, Chief Accountant, Contract Division, ONR Washington, advised us that a fixed overhead rate of 30% of salaries and wages was considered acceptable by the Navy. In his answer of 8 January 1953 Mr. Low notified Mr. Wighton of our acceptance of that rate.

II. SUMMARY OF DEVELOPMENT AND RESEARCH PROJECTS

A. 26-Foot Equatorial Table.

Reports on progress in the design, design revision, manufacture, testing, shipment, and storage of the 26-foot equatorial table form a substantial part of all 17 status reports. It should be noted once more that work proceeded simultaneously on an identical instrument for the Air Force Upper Air Research Observatory at Sacramento Peak, New Mexico, under Air Force Contract W19-122ac-17. Substantial savings to both the Air Force and the subject contract resulted from this parallel development.

Performance tests at Westinghouse Electric Corporation in Sunnyvale, California, yielded extremely favorable results (see letter to the Commanding Officer, Department of the Navy, Office of Naval Research, Washington 25, D. C., from Dr. John W. Evans of High Altitude Observatory, dated 21 July 1952). The instrument proved capable of even more precisely controlled motion than we had in mind when we first set out the specifications for an ideal mounting for large coronagraph optical systems. The equatorial table was shipped to Climax where it is in storage awaiting the building of an observatory and the completion of the 16" coronagraph, the primary optical instrument to be mounted on it. The status of completion of the mechanical

and optical components of the 16" coronagraph is described in detail on pages 5 and 6 of the property inventory submitted to the Contract Administrator as an enclosure to a letter of 10 December 1952 from R. J. Low.

B. Spicule Measurement.

Reports on this project, carried out in large part by the Navy Bureau of Ordnance Center of Analysis at Massachusetts Institute of Technology, are included in Status Reports 1, 3, and 4. The work resulted in a Special Report "Further Measures of Chromospheric Spicules" by Roberts, Shapley, Branton, and Kopal, dated 5 August 1949.

C. Experimental Modification of Fairchild Camera.

Status Reports 1 through 6 deal with efforts to modify the Fairchild film advance mechanism to provide registration accuracy suitable for use on a coronagraph. A Special Report resulted: "Registration Accuracy Tests of the Fairchild Radar Recording 35mm. Camera" by Ch'ing-Sung Yu, dated 22 December 1949. The general conclusion of the investigation was that the Fairchild camera was not a suitable device for this purpose.

D. Photoelectric Guider for 26-Foot Equatorial Table Coronagraph.

The story of this development is carried in Status Reports 3 through 9. A special report on the development was issued under Harvard University's AMC Contract W19-122a-17 ("A High-Accuracy Photoelectric Guider for Solar Telescopes" by Fowler, Johnson, and Lee, dated 29 May 1950). The guider was completed except for the optical head.

E. Prominence Analyzing Projector.

The design and construction of this instrument continued through most of the term of the contract and resulted in a very effective instrument now in service at High Altitude Observatory.

F. Photographic Spectrograph Slits.

Status Reports 10 through 12 summarize this successful development. It was presented in greater detail in Technical Report "A New Method of Making Accurate Spectrograph Slits by Photographic Methods" by Ch'ing-Sung Yu, dated 12 September 1951.

G. Sky Photometer Measurements at White Mountain.

The High Altitude Observatory's part in this evaluation project (at little cost to the subject contract) is summarized in a Special Report issued under Air Force Contract W19-122ac-17

"Atmospheric Purity at Sacramento Peak, White Mountain, and Climax" by Walter Orr Roberts, dated 25 January 1950.

H. Sunspot Kinematograph at Oak Ridge, Massachusetts.

This project was carried on at small cost to the subject contract (see Status Reports 1 through 6) and detailed in a Special Report "Solar Kinematograph at Oak Ridge, Massachusetts" by Gordon Newkirk, Jr., dated 31 December 1949.

I. Contour Densitometer.

Status Reports 9 through 16 present a resume of this development. A detailed statement is contained in Technical Report "The High Altitude Observatory Isophotal Contour Densitometer" by Fowler, Johnson and Billings, dated 29 January 1952.

III. HOUSING THE 26-FOOT CORONAGRAPH AT CLIMAX.

The 26-foot equatorial table mount and drive mechanism are in storage at our Climax site awaiting erection of a turret and enclosure in which the instrument is to be installed. We are seeking to raise funds for this building from foundation, corporate, and private sources.

During a little more than a year of intensive effort \$80,000 has been raised for this new building, though \$50,000 of this amount is conditional upon our success in raising the balance needed. We estimate an additional \$70,000 will provide a complete turret, enclosure and spectroscopic wing. We were able to reduce greatly the estimated total cost of the structure, without in any way impairing function, as the result of excellent work in re-designing by Mr. Robert Cooper and others of our staff. Specifications are now in the hands of an architect and we expect to call in bids on the construction during May. At that time accurate costs should be known.

IV. REPORTS ISSUED

A. Status Reports.

Seventeen Quarterly Status Reports were issued, covering all contract operations for the period 1 July 1948 through 30 September 1952.

B. Special and Technical Reports.

1. The Birefringent Filter by Dr. J. W. Evans, dated 1 December 1948 and issued under Air Force Contract W19-122ac-17 and Navy Contract N8onr-64801.
2. An Investigation of the Accuracy of the Mitchell Motion

Picture Camera as an Instrument for the Registration and Reduction of Solar Prominence Photographs by Dr. Ch'ing-Sung Yu, dated 30 April 1949.

- ✓ 3. Further Measures of Chromospheric Spicules by Dr. Walter Orr Roberts, dated 5 August 1949.
- ✓ 4. Registration Accuracy Tests of the Fairchild Radar Recording 15 mm. Camera by Dr. Ch'ing-Sung Yu, dated 22 December 1949.
- ✓ 5. Solar Kinematograph at Oak Ridge by Dr. Gordon Newkirk, Jr., dated 31 December 1949.
- ✓ 6. A New Method of Making Accurate Spectrograph Slits by Photographic Methods by Dr. Ch'ing-Sung Yu, dated 17 September 1951.
- ✓ 7. The High Altitude Observatory Isophotal Contour Densitometer by Mr. Fred E. Fowler, Mr. Donald S. Johnson and Dr. Donald E. Billings, dated 29 January 1952.

C. Other Reports

Several publications have resulted either wholly or partially from work under the subject contract, or using instruments developed under the subject contract. These are as follows:

- 1. "Servo Guider for Solar Telescopes" by Mr. Fred E. Fowler and Mr. Donald S. Johnson, Electronics, May 1951.
- 2. "An Isophotal Contour Densitometer" by Mr. Fred E. Fowler, Mr. Donald S. Johnson and Dr. Donald E. Billings, J.O.S.A., 43, 63, 1953.
- 3. "Eruptive Prominence Associated with Limb Flare of May 8, 1951" by Mr. Thomas J. Bartlett, Mr. Bruno Witte, and Dr. Walter Orr Roberts, Ap. J., 117, 292, 1953.
- 4. "Isophotal Photometry of a Solar Flare" by Dr. Donald E. Billings and Dr. Walter Orr Roberts, in press.

Others are in preparation whose publication will derive from research made possible, in part, by this contract.

V. ACKNOWLEDGMENTS

The staff of High Altitude Observatory wants to take this opportunity to express gratitude for some of the major contributions to the development of the 26-foot coronagraph that have come from other groups and persons. Dr. Donald H. Menzel of Harvard College Observatory deserves much of the credit for the original conception of the

instrument and its early planning. Dr. James G. Baker of Harvard College Observatory did a large share of the design work on the optics. But by far the largest share of credit for the design goes to Dr. John W. Evans, now Superintendent of the Upper Air Research Observatory at Sacramento Peak, New Mexico. On him rested the full responsibility for the engineering work that led to the successful development of this powerful new instrument. The development group of Westinghouse Electric Corporation at Sunnyvale, California, particularly Mr. George F. Gayer and Mr. Dale Phillips, deserve credit for their exceptional performance in fabricating the equatorial mount. The firm of Parra-Mantois et Cie of France took infinite pains in providing glass of the very highest quality for the critical optical components later to be installed in the instrument. We thank also Mr. Richard S. Perkin and others of the Perkin-Elmer Corporation, Mr. Jack T. Wilson of Allis Chalmers Manufacturing Company, Mr. Ray H. Dittmore of Dittmore and Freimuth, as well as the many others who assisted us in one way or another in conducting the work on this contract. Lastly we wish to express our gratitude to the Office of Naval Research for the excellent support, understanding, and co-operation given us through the long process of development.

Respectfully submitted,

William Andrews

William Andrews
Assistant to the Director

4 May 1953

VI. DISTRIBUTION

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